

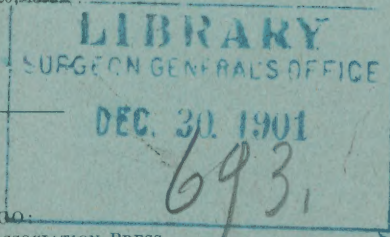
Kelly (H.A.) & MacCallum
(W.G.)

PNEUMATURIA

Presented to the Section on Surgery and Anatomy, at the Forty-ninth
Annual Meeting of the American Medical Association, held
at Denver, Colo., June 7-10, 1898.

BY H. A. KELLY, AND W. G. MACCALLUM.
BALTIMORE, MD.

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PNEUMATURIA.

During the last two centuries observations of the passage of gas with the urine have been made from time to time by various authors, and lately a number of very detailed accounts of this phenomenon have appeared. Brierre de Boismont in 1825 mentioned the spontaneous production of gas in the bladder and considered it due to a sort of flatulence or secretion of gas by the bladder mucosa. Roche confirmed this and Chomel added to the suggestion of gaseous secretion from the membrane, the idea that the gas might be due to fermentation. But up to 1860 practically all the instances were in cases of fistulous communication between the bladder and intestine, and when in that year Raciborski was called to treat a man who passed bubbles of gas from the urethra he first satisfied himself that there was no vesico-enteric fistula, before describing the case as one of spontaneous development of gas in the bladder.

The cases of pneumaturia may be roughly divided into three groups:

1. Those in which air is mechanically introduced into the bladder from without.
2. Those in which gas develops in the urinary tract through the agency of some fermenting organism.
3. Those in which there is a communication between the bladder and an air-holding viscus.

The first group is of little practical importance, as the discomfort is transient and the phenomenon has no pathologic significance. The introduction of air may occur during irrigation of the bladder if the apparatus used is not emptied of air before the fluid is allowed to flow. More commonly is the condition brought about by the knee-breast position occupied

by the patient during the cytoscopic examination as practiced by Dr. Kelly, when it forms the basis of the method of examination—the sagging of the viscera produces a negative pressure on the bladder walls which is neutralized as far as possible by the amount of air distending the bladder. After such examination when the patient is replaced in the dorsal position the air should be pressed out through a catheter, as otherwise the distention may cause considerable pain. The operation of lithotomy and the vesical operations are also sometimes followed by passage of gas into and out of bladder.

The second group of cases depends on the invasion of the urinary tract by some organism which by its action on the urine produces gas. In most of these cases the gas was produced in the urinary bladder, but in a few the kidney was evidently the seat of the infection, and in one there was a general distention of the whole tract.

Since as yet we know so little of the etiologic factors in these cases we can hardly attempt any division of the cases on such a basis. Up to the time of Favre, who isolated an organism in 1888, no attempt was made to recognize the causative agent. Most of the cases described occurred in middle-aged or old men, where there had been for some time some obstruction to the flow of urine—such as an enlargement of the prostate or gonorrheal stricture—in others there were vesical calculi. In two cases there was paralysis following myelitis. Of the sixteen cases described nine were found to have glycosuria. The data are not sufficient to determine the reaction of the urine in all cases but the majority were acid up to the time when the determining factor of the pneumaturia appeared—that is the catheterization, sounding, lithotripsy, lithotomy, etc., one of which was performed in practically all the cases and was very quickly followed by the passage of gas. The reaction of the urine after the introduction of the organism by the catheter varies with the nature of the infection.

In three cases (those of Heyse, Guiard, and Péré) there is no definite history of catheterization before the emission of gas, but there was an increase in the amount of gas after such instrumentation, and it is now practically universally recognized that such introduction of the infection by means of instruments passed into the bladder is the essential factor in the production of pneumaturia of this type.

The various conditions described as existing previous to catheterization or sounding are predisposing causes. The residual urine present in the bladder when there is some obstruction to free egress forms a favorable medium for the growth of organisms and other slight infections, associated with the presence of an obstruction and atony of the bladder, or with the presence of vesical calculi, are often favorable to the invasion of the gas-forming organism. Further, stress has been laid by Guiard and others on the importance of the presence of sugar in the urine in the production of pneumaturia, and indeed in the sixteen recorded cases there was glycosuria in nine, with one more doubtful case. Guiard himself reports four such cases. Dumesnil, Ralfe, Müller, Senator and Péré report others. Of these cases the organism was recognized in only two, that of Senator, where there was a yeast, and that of Péré, where a bacillus resembling the bacillus coli communis was the gas-producer.

In sugar-free urines the formation of gas has been observed in several cases, and from the number Favre, Schow and Heyse have made detailed bacteriologic studies. The organisms described by these authors are almost identical, differing only in details, in which there is always some variation. They all belong to the group of which the bacillus coli communis is the type, and Heyse has identified the organism in his case with the bacillus lactis aërogenes. Schow names the one found in his case coccobacillus aërogenes vesicæ. The following are the main characteristics of the three organisms; they are plump, short rodlets sometimes occurring in pairs: they grow aërobically on the

various media, forming gas in the gelatin stab cultures and not liquefying the gelatin. Favre's bacillus is motile, Schow's slightly so and Heyse's non-motile. Favre's form shows an inequality in staining, suggesting the formation of spores. Urine media become alkaline after the growth of the organisms excepting Favre's, which produces acid. Heyse's bacillus is said to produce acid also by changing lactose into lactic acid. The organisms are pathogenic to rabbits. Heyse's also to guinea-pigs and mice. The gases produced are carbon dioxid, oxygen, nitrogen, hydrogen and marsh gas.

One of the cases in which the bladder was found distended with gas is described by Welch and Flexner. In this case the organism was the bacillus *aërogenes capsulatus* (Welch) which is distinguished by its size and *aërobic* growth. The gas produced was chiefly hydrogen and burned with blue flame.

As to the actual mode of formation of the gas we have various ideas. Guiard upholding his claim that glycosuria is the basis of all such pneumaturias, considers it an alcoholic fermentation, with the liberation of CO_2 , and thinks we should find alcohol in the urine, and this has been actually done by Senator, who found in the case where a yeast was the aerogenic factor alcohol in the urine and CO_2 as the gas.

Obviously this is the explanation of the decrease in the sugar in the urine of diabetics after the beginning of a cystitis, and the formation of the fatty acids as an extension of the process explains the acidity of the urine in such a case.

In the cases where the urine is sugar-free the analyses of the gas produced have showed the presence of CO_2 , and H_2 , N_2 , O_2 , and CH_4 have also occurred, but it is suggested by Senator that these are absorbed merely from the blood. Just what is decomposed in sugar-free urine by the organisms is still doubtful.

The quantitative analyses vary so much that it is difficult to draw any general conclusions from them. In all, however, hydrogen forms the main bulk.

Other suggestions are offered as to the formation of the gas. Ralfe thinks that during the formation of acetone from aceto-acetic acid in the urine of diabetics gas might be developed. Kehrer, in describing a case of hydronephrosis in which the hydronephrotic sac was distended with gas, suggests that from the remains of the kidney tissue normal acid urine was secreted at intervals and that this set free the CO_2 from the carbonates in solution in the stagnating urine in the sac.

The symptoms in these cases are not very striking. There may be continual desire to urinate, but it is rather a result of the cystitis than of the presence of the gas, which collects in rather small amounts. The passage of the gas per urethra causes no pain, but rather a tickling sensation, and is accompanied by a souffle or even by a distinct explosive report, or a musical sound. The bladder tympany may extend almost into the umbilical region at times, but unless the patient be actually inverted, the curve and situation of the urethra is such that no gas passes until after most of the urine has been passed. The gas may pass in such large bubbles as to give rise to intermissions in the flow of the urine, or if in very small quantity it may merely form froth at the end of micturition.

Recovery occurred in practically all of the cases, the urine clearing up and again becoming acid; treatment with antiseptic lavage often greatly hastened this. The fatal termination of a few of the cases was due rather to infection of other organs than the bladder—pyonephritis with uremia.

Rather distinct from this class of cases is the group forming perhaps part two of the second division—those cases where the gas is produced in the kidney and ureter rather than in the bladder itself. Of such cases three have been reported, and a fourth has occurred during the last year at the Johns Hopkins Hospital in my own clinic. LeDentu in his text-books cites a case observed by Lannelongue in a child

aged 8, where there was a voluminous tumor in the right flank, at first mistaken for the liver. On aspiration 500 c.c. of a greenish fluid was obtained, together with a gas composed of oxygen, nitrogen and carbon dioxid. At autopsy the tumor was shown to be a renal cyst. LeDentu himself performed nephrectomy in a case where there was a renal calculus and an accumulation of gas in the kidney. This gas, as in the case of Lannelongue, was composed of oxygen, nitrogen and carbon dioxid, and he gives it as his opinion that the gas was absorbed from the blood. In the case of Tisé there was pyonephritis, with formation of a perinephritic abscess following obstruction from an enlarged prostate; evacuation of the abscess put an end to the discharge of gas from the bladder. The history of the case observed at the Johns Hopkins Hospital is briefly as follows:

Mrs. J. H., aged 36, married fifteen years, II-para, normal labors. About four months after marriage noted pain on urination. Two years later began to pass minute white calculi and during the next four years passed three larger calculi with much pain. At present has pain and swelling in left lumbar region and constant pain in bladder, especially just before urination; the urine always contains pus; for one year has passed gas from urethra in large amounts. Left kidney is felt as a hard tumor the size of two fists.

Cystoscopic examination. No. 10 cystoscope. Bladder mucosa normal. Right ureteral orifice easily found and normal in appearance and the urine clear issuing from it. The left ureteral orifice found by seeing issuing from it pus and gas bubbles. This was wiped away and the ureter easily discovered surrounded by a reddish area. On pressure over the kidney pus could be squeezed out of the ureter, and mixed with the pus were numerous air bubbles. On attempting to pass a metal catheter, a stricture of the lower portion of the ureter was discovered. A flexible, wax-tipped one and one half mm. catheter was easily passed on first attempt and entered to the kidney; no scratch marks on the wax. Pus withdrawn was thick, viscid and of a foul odor.

Nephrotomy was done and a drainage tube inserted into the kidney, after evacuating the gas and washing out the pus which was found in its cavity. The patient made an uninterrupted recovery.

Cultures from the kidney were not definitely successful in isolating a single organism. Coverslips from the pus showed

various forms, slender bacilli in chains, stout bacilli in chains and groups of cocci or short bacilli beside diplococci resembling the pneumococcus. The cultures showed mainly coccus-like organisms which did not liquefy gelatine, although the growth was here, as on agar, abundant; litmus milk decolorized and coagulated with the formation of acid; no formation in lactose agar nor in urine lactose agar. Scant growth on potato and in bouillon, the bouillon becoming clouded.

In the last group of cases the gas reaches the bladder through a fistulous communication with some air-holding viscus, which is in the great majority of the cases the intestine. Observations on such fistulas have been rather numerous, and the literature has grown to a considerable extent, especially in the last fifty years. Among the most important publications are those of Blanquinque and Harrison Cripps, the latter of whom reviewed sixty-three cases in the literature. Chavannaz within the last few months has written very fully on the subject, considering, however, only such fistulas as occur in men.

Communication between the bladder and intestine may originate in the most various ways, and the cases may be roughly divided as follows: 1, congenital fistulas; 2, cases of traumatic origin; 3, cases in which the fistula results from necrosis of tissue between the cavity of the bladder and that of the intestine.

Savoy and Minich have described cases of atresia ani in very young children, in which the intestinal contents were evacuated through the bladder by way of a fistulous connection between the bladder and the rectum. This was probably a congenital malformation rather than the result of the accumulation of the feces. Treatment by the restoration of the natural anal orifice resulted in the cure of the condition.

Traumatism plays a relatively small part in the production of vesico-enteric fistulas, and the fistulas so formed are much more amenable to treatment than those in which the formation is associated with a diseased condition of the adjoining tissues. Billroth and Fischer have reported cases in which passage of gas through the bladder followed wounding of the

rectum in lithotomy and in the cases reported by Dittel, Johnstone and Canton the fistulous perforation was due to violent catheterism. Gunshot wounds, stabs, protracted labors and retention catheters have been the cause in other cases, but by far the most common, traumatic origin seems to be in wounds of the rectum caused by falling on some sharp object, which, entering the rectum, passes through the intervening tissues into the bladder.

The tissues being in good condition, healing often takes place if the patient is merely kept at rest and the bladder and rectum kept as free as possible. In most of the cases frequent catheterization or the introduction of a retention catheter has been resorted to. Chavannaz states that the traumatic cases form 13.86 per cent. of all cases in men, but if we consider the fistulas in women, also, this is a rather too high estimate, and the figures approach more nearly to 11.4 per cent. of all cases.

The non-traumatic fistulas are produced by the necrosis of tissue between the cavity of the bladder and that of the intestine, after these organs have become adherent or by the necrosis of the walls of these organs, so that communication is established through an intervening cavity, such as an abscess cavity.

The old division of these cases into cancerous, tuberculous and inflammatory is adopted by Chavannaz, but it is sometimes rather misleading and the dividing lines can never be sharp. In almost half of the cancerous cases the cancer is only indirectly the cause of the fistula in that it forms a stricture of the intestine, the fistula being produced at a higher level. Chavannaz in his statement that the cancerous cases form more than 20 per cent. of all the cases seems to overlook this—the percentage of fistulas actually due to the breaking down of a cancer, involving both bladder and intestine, is probably under 10 per cent. Several English authors, Hunter, Blizzard, Heuston, Richardson and others have described such cases

where the fistula was directly due to the invasion of the bladder wall by the carcinoma, and the subsequent breaking down of the mass. Tavignot, Peron and Czerny have also described similar cases.

Stricture of the rectum seems to have a very important influence in the production of fistulas, whatever may be the origin of the stricture, although no writer has laid especial stress on this point. The intestine above the stricture becomes distended and feces stagnate there; indeed a complete lining of feces may be formed with a secondary lumen through which the liquid stools pass, and such stasis, combined with the severe straining at stool to produce an inflamed condition of the intestinal wall and peritoneal adhesion, are followed by ulceration through the wall into the adjoining bladder. Foreign bodies which have become lodged above the stricture often aid in this process.

From the side of the bladder the causation of fistula is very doubtful. Stricture of the urethra has probably only a predisposing influence in causing cystitis, etc. Mercier describes two cases in which the autopsy showed that ulceration had occurred at the bottom of several of the sacculations or cellules in the bladder wall, and that communication with the intestine had originated in this way.

Calculi have been said to ulcerate through the walls, especially if they have become lodged in depressions, but as Chavannaz remarks, they are more probably the result than the cause of intestino-vesical fistulas. Further, fistulas have been ascribed to the long-continued use of stiff retention catheters and sounds, necrosis of the vesical wall occurring where the beak of the sound pressed upon it: also to the presence in the bladder of long, hard, foreign bodies introduced from without for various purposes.

Probably the largest group is formed by those cases where at autopsy there is no stricture of the intestine nor any carcinomatous mass, but instead peritoneal adhesions between one or more loops of intestine and

the fundus of the bladder, with perforation at the point of adhesion. These adhesions may be limited to a very small area, merely forming a thick wall for the fistulous tract, or they may be very extensive, matting the intestines. Flanner describes such a case where the matting was due to a tuberculous peritonitis and Robouam another where, among the coils of adherent intestine, there was a large abscess cavity communicating with the intestine and with the bladder. Frequently the communication is not direct, but through a space walled up by adhesions from the peritoneal cavity in which there is a collection of intestinal contents, urine and pus, and sometimes foreign bodies. Chavannaz has found such a *foyer intermediaire* in 22.10 per cent. of the cases. The course of the fistulous tract is thus not always direct; in some cases the openings are directly opposed, in others the canal is long and tortuous after running for some distance between the coats of the intestine and bladder. This disposition may result in a valvular action of the fistula so that materials can pass only one way.

Fistulas have resulted in various other ways. Rupture of abscesses in the pelvis, into the bladder and intestine, has occurred in a considerable number of cases. This is especially frequent in women, where tubal abscesses and other suppurative processes in the pelvis are common. In men, somewhat similar conditions have occurred, sometimes originating in inflammation of the appendix, although when we consider the number of appendix abscesses that are seen it is somewhat remarkable that in Chavannaz's statistics the appendix is concerned in the formation of such fistulas in only one case or 1.85 per cent. Very recently Fowler of New York has reported a case in which an appendix abscess was probably the cause of the fistula.

Connection of the two organs by means of an adherent cystic ovary has been described by Simpson, and in an inaugural dissertation Giessler described the

formation of communication between the bladder and intestine after the rupture of an extrauterine pregnancy, with discharge of fetal parts through the various channels. Finally, Schoepffer relates the case of a child in which the breaking down of a small-celled sarcoma of the intestine; which had become adherent to the bladder, gave rise to the passage of intestinal contents into the bladder.

Another class of cases originates in tuberculous and suppurative processes in the tissues between the rectum and the bladder. Tuberculosis of the prostate passing into cheesy degeneration with discharge both ways is the basis of several cases; while gonorrheal abscess of the prostate and neighboring tissues may have a similar result.

The situation of the orifice of the fistula is rather important in determining the symptoms and governing the treatment. Chavannaz's statistics are as follows, in the cases in which the point was determined by autopsy: In 44.44 per cent. the communication was with the rectum; in 24.07 per cent. the communication was with the sigmoid; in 11.11 per cent. the communication was with the colon; in 7.40 per cent. the communication was with the colon and ileum; in 1.85 per cent. the communication was with the appendix.

The intestinal as well as the vesical orifices may be multiple and may be situated in different sections of the intestinal canal. This of course complicates greatly the operative treatment, and in the intra-peritoneal treatment of such cases the question arises as to whether it is better to resect the intestine or to perform a number of lateral sutures. It will be readily seen that since the rectovesical fistulas form such a large percentage of the cases we may expect to find the majority of all the cases in men, and indeed Chavannaz's statistics uphold this in showing that 70 per cent. of all the cases were in men.

Affection of the kidneys is relatively uncommon, the bladder seeming to act as a protection against the passage of the infection up the ureters. Purulent and

ammoniacal cystitides may, however, occur, and obstruction, due to the blocking of the urethra by the fecal matter is not infrequent.

The symptoms vary with the nature and origin of the lesion. There may be no symptoms whatever previous to the passage of gas, and later of feces, from the urethra, or frequent and painful micturition may occur during the formation of adhesions and the general signs of a local inflammatory process may be present. Passage of gas is always the most constant symptom and may precede the passage of fecal matter through the urethra. Of course pneumaturia is not an invariable accompaniment of vesico-enteric fistula; all the material transmitted by the fistula may pass the other way and we may have clear urine and urinous stools. Indeed, the passage of urine per rectum is very common, and especially noticeable when the intestinal orifice is low in the large intestine. The urine in the intestine may cause a diphtheritic inflammation of the mucosa, giving rise to a constant diarrhea. The passage of gas into the bladder is rarely perceived, but in some cases it may give rise to an immediate desire to urinate. From the urethra it may be passed with wheezy or even with a loud noise; indeed, one patient described by Wegscheider, was nicknamed "die Luftschiifferin" on that account. The quantity is variable, but the odor is generally fecal, unless, as in the case of Jewett, the opening into the intestine is very high. It generally appears at the end of micturition and is sometimes affected by the position of the patient, being passed only when he is in the erect position, etc. Fecal material passes with the urine in variable amounts, sometimes enough to form a slight granular sediment, sometimes in such mass that the urine has the appearance of thick soup. At other times the fecal material may form more solid masses or be forced through the urethra in cylindrical moulded lengths. Foreign bodies, such as bones, seeds, etc., sometimes pass through the urethra, causing great pain. *Ascarides*

have been passed at intervals in some cases, notably that of Krachowizer, and thought to have been the cause of the fistula, but other authors have suggested that it is more probable that the ascarides merely took advantage of the already formed fistula. When the opening is high up in the intestine the intestinal contents, as they reach the bladder, may, as in the case of Jewett above referred to, be so little changed that the whole food of the patient can be recognized. The discharge of fecal matter through the bladder may be intermittent, ceasing for days at a time, or appearing only when the intestinal contents are fluid, as for example after a purge. The gas is, however, rather more constantly passed. Micturition may be frequent and painful although many patients have no pain whatever.

The stools are very frequently affected by the connection of the intestine with the bladder, there often being a continual diarrhea. In some cases a formed stool may be followed by a completely liquid one, the sphincter being able to retain the fluid which has reached the intestine, so that a large amount passes at once at stool, instead of a continual dribbling. The symptoms are fairly well illustrated by the following cases, which occurred lately at the Johns Hopkins Hospital:

Case 1.—Mrs C. A., aged 60, came complaining of the passage of gas and feces through the bladder. Her family history and early personal history throw no light on the present illness. In February, 1896, she began to have a pain in the lower abdomen; urine was thick, with a brown sediment, and very offensive for the first two months. Gas began to appear with the urine in June. In July, being constipated, she took licorice powder and the resulting movement passed through the bladder; was better then for a time. In October she submitted to an operation for the cure of a suburethral abscess. For several months the passage of feces ceased. In April, 1897, it grew worse and she passed a great deal of feces and gas with the urine. In July the discharge ceased a little, gas occasionally present. In November had severe attacks of intestinal pain and passed from the bladder what she thought was its lining. Since November the discharge has been rather less up to January, 1898, when it grew worse again. The presence

of gas in the bladder was associated with a continual desire to urinate—never was there any pain from distension, however. The gas was discharged with a loud sound easily heard by those in the room or even in the next room. It had a fecal odor. Sometimes some pain in the abdomen on passage of gas. Not much pain in urethra except when the suburethral abscess was present. Controlled the gas as she did the urine. Since January has passed a great deal of feces through the bladder, the amount being increased when the bowels do not move with sufficient frequency. The urine showed the presence of a brownish sediment containing striped muscle tissue, partly digested vegetable shreds, starch, an egg of trichocephalus dispar, pus, granular and hyaline casts. Cultures and cover-slips showed the intestinal bacteria. The urine contained albumin and an increased amount of indican.

On administration of bismuth subnitrate by mouth the characteristic black crystals of bismuth sulphid appeared in the urine. So also injection of a blue solution per rectum colored the urine blue.

Cystoscopic examination of the bladder gave the following: A No. 11 speculum introduced and bladder expanded to 63 cm. from internal urethral orifice to posterior wall.

In the posterior hemisphere the capillaries are much increased, this increased capillary vascularity becoming more marked toward the base of the bladder, where there is a uniform rosy injection.

Irregular deposits of pus over the base of the bladder, which is deeply injected. A No. 13 speculum introduced and a calculus extracted with mouse-tooth forceps, together with two small bits. In posterior hemisphere on the left, at the junction of the upper and lower quadrants, is a puckered surface extending slightly crescentic upward (knee-chest position) with its canal directed upward and backward about 8x3 mm. The borders are deeply injected over an area about 3 to 5 mm., but beyond this the surrounding tissue is comparatively normal.

Right ureter is deeply injected around its orifice and almost exactly in the median line; the left ureter is displaced to the left. There is around the right ureteral orifice a membranous deposit almost pure white, and cover-slip from this showed it made up of short bacilli and pus cells.

Rectal mucosa normal.

At operation the sigmoid flexure of the colon was found adherent to the bladder at the vertex on the left side. Area of adhesion 2.5 mm. in diameter, free on all sides so that the finger can be hooked under it, lifting it from the pelvis.

The two organs carefully dissected apart, protecting the peritoneal cavity with gauze; fistula 2 mm. in diameter cut through. Vesical orifice brought together by means of interrupted catgut sutures making a line from above down and to the left 4 cm. long. Dense fibrous tissue was then cut off the

rectum, and mucosa lining the fistula cut out, making the opening into the bowel about 2 cm. long, with shelving sides in healthy tissue, this also closed with interrupted silk sutures about 2 mm. apart. Salt solution irrigation of the peritoneal cavity. Abdomen closed without drainage. Bladder drained by retention catheter and occasionally washed out.

The patient made a perfect recovery, the urine clearing up at once and the passage of gas ceasing immediately. Convalescence has been uninterrupted.

Case 2.—Miss J., aged 57; admitted to the Johns Hopkins Hospital in November, 1890. Menses regular up to age of 48. At 42 had swelling of legs with vaginal hemorrhages; since age of 50 these have occurred at intervals. Have grown worse lately.

Right and left tubo-ovarian masses made out. Celiotomy was performed and the tubo-ovarian cyst on left side dug out of adhesions in lower part of pelvis. Cyst ruptured, discharging 30 c.c. of thick, sticky, mud-like substance. Right tube and ovary also removed; foul odor suggested an opening into bowel. Pus discharged from uterine cavity came from a tumor in the body of the uterus.

Patient recovered. In March, 1896, she was readmitted, complaining of general pelvic pain. Vaginal puncture was performed, evacuating dark fluid blood and clots from a sac between uterus and bladder, puncture being performed in front of the cervix.

She was then passing bubbles of air at the end of micturition and there was pus in the urine. Cystoscopic examination showed an orifice 1.5 mm. in diameter in the left lower quadrant of the posterior bladder wall, from which pus exuded; a sound was introduced about 1 cm. into this. In March, 1898, at age of 64, she consulted Dr. Cullen, who found on examining the bladder a slight injection around the trigone and a marked reddening above and to the left side; no opening could be made out, although bubbles of gas and particles of feces could be seen coming from the injected area. Injection of milk into the rectum appeared at once in the bladder. March 23 the abdomen was opened and the upper left side of the bladder found firmly attached to the rectum just at the pelvic brim. The adhesions were gradually separated and a firm cord 1.1 mm. in diameter found connecting the gut with the bladder. This was cut through at the expense of the bladder wall. The edges of the rectal opening were then turned in and the wound closed by two rows of mattress sutures. Vesical opening similarly closed. The patient did well for twenty four hours, but her weakness was such that she succumbed. There was no peritonitis nor hemorrhage.

In this case it is probable that the stump of the left tube had become adherent to the rectum after the removal of the appendages eight years before, and that in this way the blad-

der was drawn up snugly against the rectum. Adhesions soon formed, and the fistulous opening followed in the same way that a dermoid cyst may become infected from the intestine after adhesions have formed.

The diagnosis of the condition is generally easy. Passage of gas, together with fecal material, is practically pathognomonic of the existence of fistula, although the passage of gas alone is not so. The blackening of a silver sound in the bladder occurs also in those cases of hydro-thionuria described by Rosenstein, Scott and others, so that that test in showing the presence of sulphuretted hydrogen, does not necessarily demonstrate the presence of a fistula. Colored injections into the rectum or into the bladder have been used very frequently, and when they give positive results are important. The most useful of these solutions are those in which the coloring matter is in suspension, rather than solution, as some materials such as methylene blue are readily absorbed and secreted in the urine. Milk, suspension of carmine, prussian blue, etc., have been used. In other cases solution of some easily recognized chemical such as the salts of iron, have been injected and the urine appropriately tested. Exploration of the bladder by means of a sound does not give the certain results ascribed by some authors, but rectal examination is of extreme value in many cases. Chavannaz lays stress on the bimanual recto-abdominal palpation. Perhaps the most important of all is the direct cystoscopic examination either by means of the Nitze-Leiter cystoscope, or better by inflation of the bladder with air and direct examination with the vesical speculum, as was carried out in the cases just reported.

The gravity of the prognosis depends, to a great extent, on the etiology, position and size of the fistula. Generally speaking, those of traumatic origin much oftener terminate favorably than those of inflammatory origin; indeed, there are reported several cases of healing after a mere rest treatment. In the carcinomatous and tuberculous cases the mechanical re-

sults of the fistula are superadded to the effects of the primary disease. In the cases of intestinal stricture the prognosis is modified by the presence of the stricture, which limits the operative measures for the cure of the fistula. In many of the cases where the fistula is small and does not transmit a great deal of material to the bladder, the patient may live years in comfort; the passage of gas alone with the urine may go on for a very long while without any inconvenience, but when the opening is larger there is constant danger of obstruction of the urethra and choking of the bladder with feces; uremic symptoms may develop followed by death. Renal symptoms are comparatively rare when we consider the condition of the bladder. The formation of a sac in the course of the fistula between the bladder and intestine adds greatly to the gravity of the prognosis, as there is an accumulation with absorption of toxic substances.

Apart from the mechanical results the general health may be disturbed. When the fistula is high up nutrition is interfered with in so far as the contents of the upper intestine pass through the bladder instead of through the remaining intestine. Vomiting, fever, insomnia, symptoms of intoxication may appear and death may result from general exhaustion or from acute peritonitis.

Treatment is palliative or curative. Palliative treatment consists in such general measures as promote the comfort of the patient by decreasing the amount of fecal discharge in the urine and keeping the rectum and bladder washed clean. A rigid régime of food producing but little feces should be observed; the patient may be kept in a position such that gas only passes into the bladder. Iliac colostomy may be considered palliative; like enteroanastomosis, it has in some cases proved curative, as reported by Pennell, Holmes, Bryant and others.

Curative treatment is in most cases operative. The operations that may be performed in cases of vesico-rectal fistula are more numerous naturally than those

suitable for fistulas into the intestine higher up. Briefly these methods are, as described by Chavannaz:

1. The rectal method in which the edges of the fistula are freshened and sutured through a speculum inserted into the rectum.

2. The transvesical, in which an extensive suprapubic cystotomy is done and the vesical orifice sewed up after freshening the edges, the sutures being knotted inside the bladder.

3. In the perineal method a dissection is made through a perineal wound, separating the rectum from the prostate and reaching the cul-de-sac; freshening and suture of the fistula is then carried out if practicable.

4. Resection of the sacrum with a gradual separation of the rectum has been advised.

5. The transpelvic operation with an incision through the pubes, or symphyseotomy and subsequent dissection backward.

6. Most satisfactory of all, both for intestinal and rectal fistulas in the hands of an experienced surgeon, is the transperitoneal method described in detailing the case of Mrs. A., although there are some cases where the fistulous tract is deeply sunk in the pelvis, where this method would be very difficult to apply.

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